

# FACIES STUDIES ON THE PLIOCENE AT BUDAPEST

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## ZUSAMMENFASSUNG

Das Pliocän im Karpaten-Becken ist ein selbständiger Sedimentzyklus, der sich im allgemeinen mit Erosions-Diskordans auf die älteren Formationen ablager.

Gleichzeitig mit der weiteren Erhöhung und der Abrasion der Karpaten und des Mittelgebirges, sank der Beckenboden mit veränderlicher Geschwindigkeit, als dessen Ergebnis folgten die Transgressions und die Auffüllungsperioden mehrmals innerhalb der Pliocänära nacheinander.

Auf dem Gebiet von Budapest befanden sich im Pliocän bis ans Ende Beckenrand-Facies, aber je Zeitalter und je Platz in sehr mannigfaltiger Ausbildung.

## Introduction

The Pliocene rocks of Budapest have been studied in several works so far, and a comprehensive paper (Földvári 1931) supplied the distribution of some facies-types with paleogeographic and tectonic evaluation. The common failure of the previous investigations was the lack of the over-all evaluation of the different facies features, as well as the lack of the ostracode studies.

Owing to the considerable facies sensity of the ostracodes, these studies enlarged significantly the informations for the geological evaluation. The shore-line reconstructions given by Földvári were confirmed by the recent lithological and paleontological studies, but the previously outlined development was slightly modified.

The present paper deals with the paleogeographical reconstruction based on the studies carried out in the years of 1970 – 72.

### *Lower Pannonian*

Within the studied area rocks of Lower Pannonian age are exclusively known around the villages Diósd and Nagytétény. At Diósd the Sarmatian limestone is unconformably overlain by sand and clay of 1 to 5 m thickness, and these are followed by a 22 to 34 m thick quartz-sand, which suitable as moulding sand after preparatory processes. The cross-bedding, as well as the overlying coarse gravel of this quartz-sand suggests nearshore deposition. Presumably equivalent in age and facies is the

light-grey quartz-sand overlying the Sarmatian limestone in the Gubacs brickyard, though the hanging wall is here the Upper Pannonian clay. Because of water-protective causes the quartz-sand is unexcavated in the clay pit; it is known only from boreholes. This quartz-sand is unfossiliferous, both its grain-size composition and roundness are equivalent to those of the sand at Diósd.

In the Lower Pannonian pelitic rocks bordering the Tétény Plateau a striking tendency to transgression can be recognized.

The Sarmatian coarse limestone is immediately overlain by greenish-grey calcareous clay. Together with the autochthonous, characteristic Lower Pannonian ostracodes [*Hungarocypris sieberi* (M é h.), Pl. I., fig. 3., *Amplocypris minuta* Z a 1., *Candona* (*Camtoocyprina*) *granulosa* Z a 1.], occur in large numbers derived Sarmatian foraminifers [*Rotalia beccarii* (L i n n é), *Elphidium crispum* (L i n n é), Pl. II., fig. 3.] and otolithi (Pl. II., fig. 1.). Streams carrying detritus did not exist in the vicinity, the fine-grained material of limited quantity was floated from a distance. The influx of the  $\text{Ca}(\text{HCO}_3)_2$  solution from the coarse limestone surroundings could have bear a significance. From 68%  $\text{CaCO}_3$ -content of the limestone originates in 23 percent from the fossils and in 45 percent from the submicroscopic micrite. In the overlying rock the derived Sarmatian faunal elements are subordinated. The 74%  $\text{CaCO}_3$ -content consists of molluscan detritus (49%) and micrite (25%). The majority of the Pannonian ostracode fauna [*Pontocypris redunca* Z a 1., *Hungarocypris pannonica* (M é h.), Pl. I., fig. 2., *Hungarocypris trapezoidea* (M é h.), Pl. I., fig. 1., *Candona fossulata* P o k o r n ý, Pl. I., fig. 8.] fragmented before the burial, but the specimens embedded unbroken remained intact later. The uppermost rock-type is a fine-grained clay, with 31%  $\text{CaCO}_3$ -content, which originates in 4% from the fossils, and in 27% from the micrite. Sarmatian faunal elements are completely absent. On the cleavage planes of the rock it is recognizable, that the Pannonian ostracode remains embedded unbroken, and fragmented later by the considerable compaction of the sediments.

The fauna reconstructed from some entire specimens and determinable fragments cannot be identified with any other Hungarian association known so far.

One species of the genus *Hemicytheria* (Pl. I., fig. 7.) resembles the *Hemicytheria pokornyi* S o k a č species, but it is presumably a new subspecies. Owing to the scarcity and the poor preservation of the specimens, a precise description of the available forms cannot be given.

The above mentioned phenomena can be interpreted as the results of slow deepening of water and negative shore-line displacement.

The upper part of the Lower Pannonian is not represented in the area of South Buda.

In the Budapest district, on the left side of the Danube, the only Lower Pannonian rock — apart from the afore mentioned uncertain grey sand of Gubacs — is known from the old Eugel-well (L ő r e n t h e y 1902). On the basis of its faunal association it can be identified with the



Tinnye locality of similar age. According to Földvári, it is hard to say whether this occurrence is a bay sediment, or an erosional remnant of the pre-Upper Pannonian land (Lörentz 1902). On the basis of the similarity with the lagunal facies of Tinnye, it is probably a bay sediment.

### *Upper Pannonian*

In the clay-pits of Kőbánya the Upper Pannonian *Congeria ungula caprae* horizon lies disconformably (with 10–20° angular unconformity) upon the Sarmatian coarse limestone. Characteristic rock-types are:

1. Grey, soft clay, commonly with carbonized plant remains. On the cleavage planes the monoctyledonous features are recognizable (Pl. II., fig. 2.). The ostracodes are frequent (Pl. I., figs. 4–6.) and subordinatedly a few bivalves are also present. On the basis of the washing concentrate two types of this argillaceous facies can be separated: the first with its 5% ostracode, 60% muskovite and 35% carbonized plant remains (Pl. II, fig. 4.) shows near-shore, the second with the 10% ostracode, 20% muskovite and 70% carbonized plant remains (Pl. II., fig. 5.) suggests an off-shore sedimentary environment.

According to these present studies the threshold value of the presence of ostracodes can be dated as the maximal 10% quantity of the 0,1 mm grain-size fraction.

2. Within the clay, sharply bordered sand layers intercalate, which lack ostracodes, but yield bivalves in great profusion (Pl. I., figs. 9–10.). These intercalations can be interpreted as temporary sand transportations of a river, which disturbed the fine-grained near-shore clay deposition, and caused the mass extinction of the rare bivalves. Because of the scatterly occurrence of the localities, it is doubtful, whether this phenomenon can be due to detrital transportation of the river, or to epeirogenetic oscillation. An additional evidence for the near-shore deposition of the brickyard clays is the relative frequency of the vertebrate fossils: *Mastodon longirostris* K a u p. mandible, *Axis* sp. antler. The lack of the entire skeletons suggest a slight redeposition of these bones.

The rocks of the *Congeria balatonica* horizon resemble lithologically and sedimentologically those of the *Congeria ungula caprae* horizon, but the corresponding facies show southward tendency in surfacial occurrence.

The characteristic marginal sediment of the Upper Pannonian (Földvári 1931) is the 0,5 to 2,0 m thick limonitic sand. It can be found, with considerable local interruptions, from the village of Érd to Veresgyháza. Its occurrence certainly shows the ancient coastal line.

The transgression upon the Miocene rocks took place on the left side of the Danube, in the *Congeria ungula caprae*, while on the right side in the *Congeria balatonica* times, respectively.

The overlying deposits of the *Congeria balatonica* horizon are the characteristic fluvial cross-bedded sand with mollusc-detritus of the Unio wetzleri horizon.

## PLATE I.

Fig. 1. *Hungarocypris trapezoidea* (M é h.) Nagytétény, 30X

Fig. 2. *Hungarocypris pannonica* (M é h.) Nagytétény, 30X

Fig. 3. *Hungarocypris sieberi* (M é h.); valve shape changes during the ontogenesis:  
a) neanic, b) juvenile, c) adult specimen Nagytétény, 30X

Fig. 4. *Paracypris (Pontonella) acuminata* Z a l. Kerámia brickyard. 30X

Fig. 5. *Paracypris (Pontonella) paracuminata* K r s t i ě Kerámia brickyard, 30X

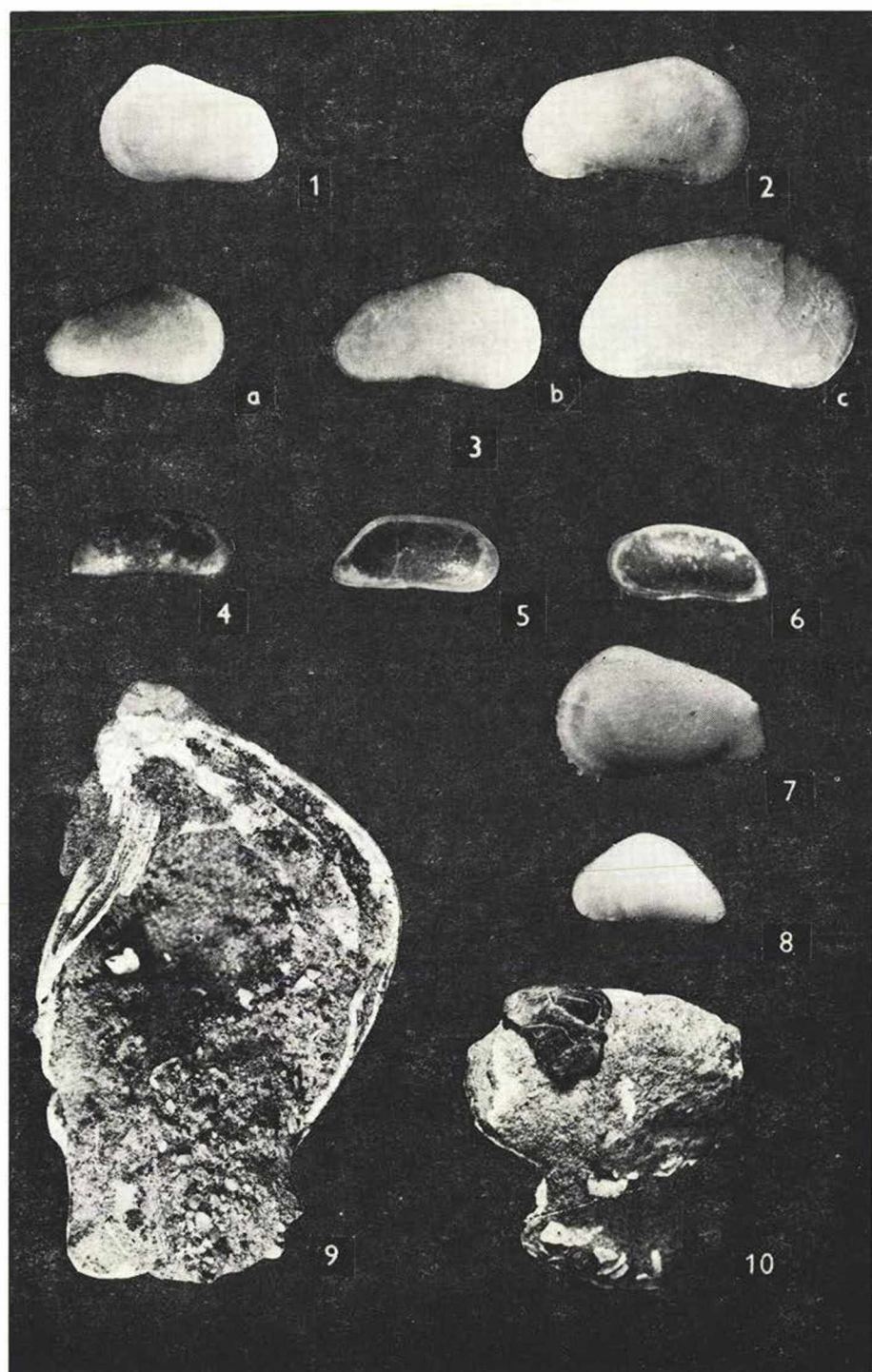
Fig. 6. *Caspiolla lobata* (Z a l.) Gubacs brickyard, 40X

Fig. 7. *Hemicytheria pokornyi* S o k a ě Nagytétény, 30X

Fig. 8. *Candona fossulata* P o k o r n y Nagytétény, 40X

Fig. 9. *Congerina ungula caprae* M ü n s t. Gubacs brickyard, nat. size. The matrix is coarse sand and gravel, cemented with iron sulfide

Fig. 10. *Dreisseniomys schöckingeri* F u c h s and *Limnocardium penslii* F u c h s shell fragments and quartzite pebble in medium-grained, iron sulfide cemented matrix. Gubacs brickyard, nat. size.



## PLATE II.

*Fig. 1.* Otolithi Nagytétény, 40X

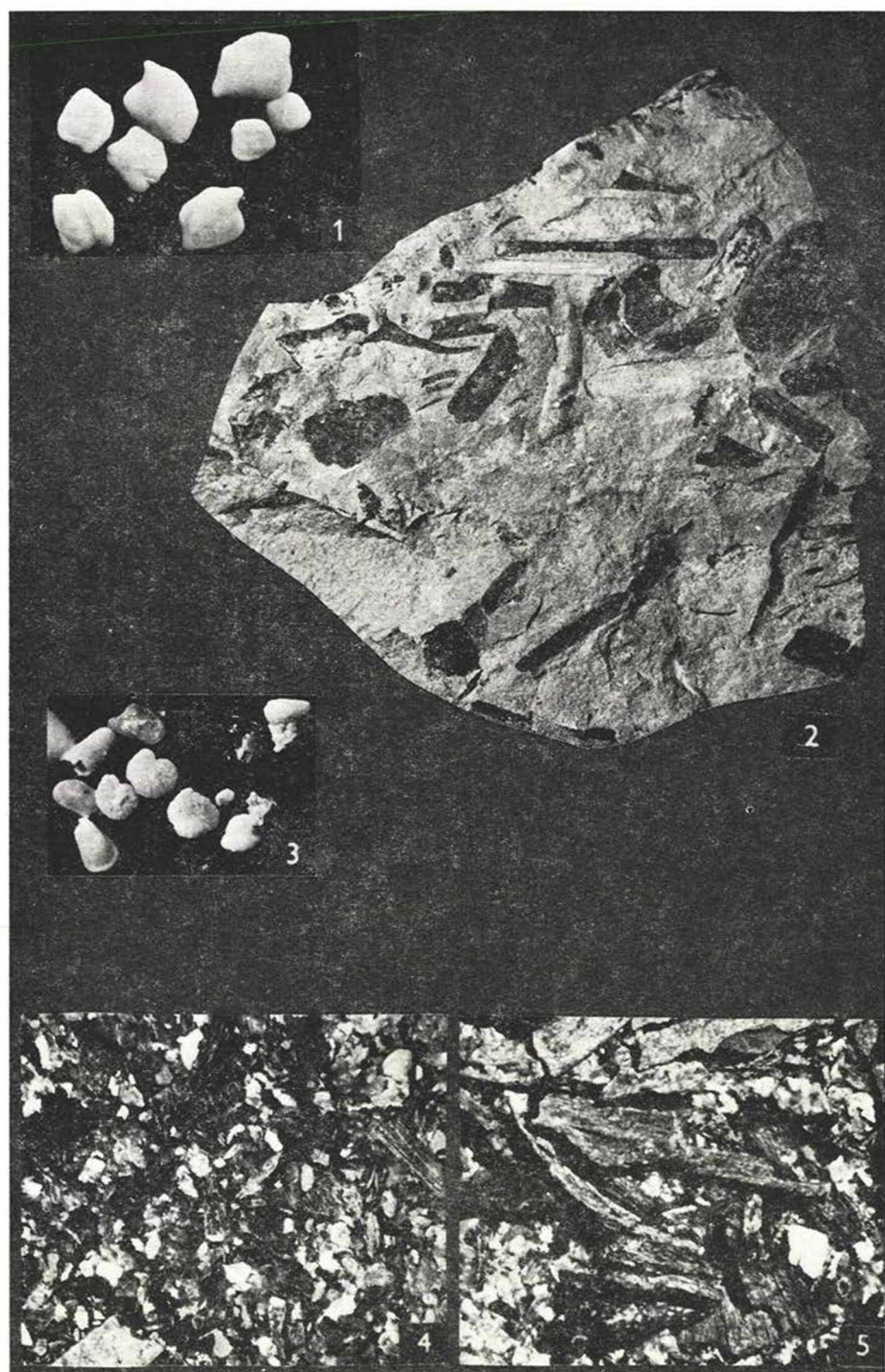
*Fig. 2.* Stem and leaf imprints of monocotyledonous plants. Gubacs brickyard, nat. size.

*Fig. 3.* Derived Sarmatian foraminifers in the Lower Pannonian clay. Nagytétény, 20X

*Fig. 4.* Medium-rich washing concentrate. Gubacs brickyard, 5X

*Fig. 5.* Faunal rich washing concentrate. Gubacs brickyard, 5X





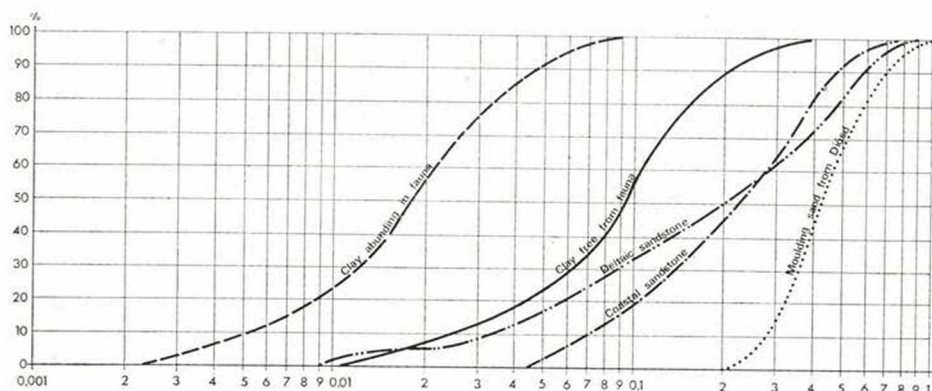


Fig. 1. Typical grain-size characteristics of some distinctive clastic rocks

In the old, small localities existed on the Szabadsághegy-hill of Buda the faunal sands and sandstones of the *Congerina balatonica* horizon were excavated. This faunal portion is unknown here at the present. On the basis of the stratigraphic position and the grain-size composition these are characteristic deltaic sediments.

#### "Levantine" (*Upper Pliocene*)

On the studied area — apart from smaller, local terrestrial sedimentation — only the fresh-water and lacustrine limestone deposition was significant both on the sides of Buda and Pest (Noszky 1925). It can be found in larger or smaller erosional remnants around Csillebérc, Szabadsághegy-hill and Rákoskert.

#### *Development and tectonics*

The studied area is one of the best known Pliocene region of Hungary, however several uncertainties exist in the point of view of geological interpretation. Owing to the generally loose, lesser petrified character of the Pliocene rocks, the origination is hard to determine after an occasional denudation and redeposition. The greatest obscurity of a model for the development derives from the interpretation of a hiatus, i.e. gap in the sequence can be due to an interruption of the sedimentation, or a subsequent erosion.

It seems to be evident, that at the Miocene/Pliocene boundary a terrestrial, erosional period have been existed.

The special sand of Diósd and the clay excavations of Nagytétény as well, suggest a general transgressive character for the Lower Pannonian in the area of South Buda. On the left side of the Danube the Lower Pannonian is known from scattered spots, which are presumably of lagunal origin.



The 10–20° unconformity at the Sarmatian/Pannonian boundary which can be recognized in Diósd, Gubacs and Kőbánya as well, is the result of the Attic orogenic phase.

The center of the Upper Pannonian sedimentation situated on the left side of the Danube, where the transgression started as early as Congeria ungula caprae times. On the contrary, the transgression reached the South Buda region in Congeria balatonica times. The sedimentation cycle generally ends with the fluvial deposits of the Unio wetzleri horizon.

In several places a 5 to 8° angular disconformity can be recognized between the Pannonian and Pleistocene-Holocene sediments. In absence of any other evidence, it can be connected to the Rhodanic or Valachian orogenic phases.

Secular movements have been acted in the geologically recent past too, i.e. the dip of the Pleistocene and Holocene strata is 1 to 3° in SE direction.

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